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ABSTRACT

The development and use of the faculty staffing formula for Colorado, prepared by the Association of Public College and University Presidents (APCUP), is examined, and a recent major attempt to update or modify the formula is described, along with the outcome. Based on the work of representatives from many campuses, a large scale computer simulation was developed, using as input numbers of full-time-equivalent faculty and students for each two-digit code of the Higher Education General Information Survey and for four student levels. The student-faculty ratios were initially determined for each discipline/level combination, and by overlaying the student mix for each campus on the matrix of ratios, projections were made of the total faculty needed by each campus. The first iteration of the process resulted in substantial reallocation of faculty both within and between campuses. Subsequent iterations caused the individual ratios to be adjusted based upon experience, campus data, and analyses of individual campus priorities. The 4 x 36 matrix clearly differentiates by level of instruction and by discipline at the same time equity in the distribution of resources is promoted by requiring all campuses to request resources at the same productivity level for instruction at a given level and discipline. Role differentiation is promoted by overlaying each campuses' student mix, by discipline and level, on the matrix of ratios. It is suggested that the formula achieved the goal of moderating the decline of faculty resources but failed to reduce the general debates over equity, role differentiation, and appropriate funding levels. A new approach that reduces line item accountability and that is compatible with increased budget flexibility has been approved. (SW)

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Planning Faculty Staffing For the 1980's A Case Study

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I. Introduction

The annual budget process in higher education consists of institutions determining their needs and presenting a budget request to increasingly sceptical trustees, governors, and legislators. These "appropriating agencies" must not only determine what is justified but also strive to allocate increasingly scarce resources equitably and in approximate conformance to individual campus role and mission.

According to Halstead[1], the greatest scrutiny is probably excercised by State legislators. In Colorado, for example, the very general "lump sum" appropriations of the late 1960's and early 1970's gave way to detailed and perscriptive line-itemed budgets. Post audit variance analysis became common and fiscal retribution followed for those agencies unable to justify their decisions or to remain politically insulated from the budget process. Budget formulas became one effective means used by legislative staff to control by line items. Legislative staff apparently agreed with Miller[2] that formulas were an effective procedure for estimating future resource needs based on current and forcasted objective or quantitative data. By the mid 1970's several formal and informal "formulas" were in common use by legislative staff. Formulas in use included:[3]

Campus-level student/faculty ratios
Academic support staff/faculty ratios
Student service staff per "x" head count students
Custodial staff per "x" thousand square feet maintained
Administrative staff per "x" faculty

By the mid 1970's, however, the higher educational leadership of the state began to recognize that, even with modest enrollment growth, the proportionate share of state dollars going to education had been steadly declining. (4) Further analysis indicated that the formulas being employed by legislative staff were being gradually altered in such a way as to reduce state support. This caused the presidents of Colorado institutions to rejuvenate a state-wide voluntary organization known as APCUP, or the Association of Public College and University Presidents. APCUP began setting up working committees to devise rational and equitable formulas for the budget process. These committees covered:

Faculty staffing levels	Library Staff	General Administration
Faculty Support Staff	Library Acquisitions	Physical Plant Staff

The general charge to the committees included:

1. The formulas were to be rational and promote the standardization of budgetary data.

2. The formulas were to possess high validity.

3. The formulas were to provide the legislature with a means of equitably distributing resources across the campuses of the State.

4. The formulas, while they were to be designed to promote change, were not to cause any significant re-allocation of existing funding bases between campuses.

This paper chronicles the development and use of the APCUP faculty staffing formula. Its conceptual base, strengths and weaknesses are displayed and analyzed. Finally, a recent major attempt to update or modify the formula is described and the some what unusual result is analyzed.

II. Development of APCUP Faculty Staffing Formula (1976-77)

The team of educators who worked on the faculty staffing formula came from many campuses and included university executive officers, senior budget staff, institutional researchers, and a small number of academic administrators. The "Faculty Committee" was given the use of the computing center at the Colorado School of Mines and the state level budget and faculty staffing detail collected by executive and legislative agencies. The committee studied existing staffing formulas including techniques in use, currently and formerly, in California and Texas.(5) Also analyzed was the current legislative staff "formula process", FNA, or faculty needs analysis. FNA was a technique which displayed student faculty ratios by discipline for all public colleges in the state; i.e., English (all levels of instruction) might be 18:1 at state college A and 16.5: 1 at university X. (Note: These detailed analyses were made possible because campuses were reporting students and faculty at the two digit HEGIS level).

For a brief period the committee considered alternatives to student-faculty ratios such as instructional costs per faculty or per student, but it was ultimately decided to keep staffing needs separate from staffing costs.

The technical approach used was to develop a large scale computer simulation

using as input numbers of full time equivalent (FTE) faculty and students for each two digit HEGIS and for four student levels (lower division, upper division, graduate 1, and graduate 2). The student-faculty ratios were initially determined for each discipline/level combination, and by overlaying the student mix for each campus on the matrix of ratios projections were made of the total faculty "needed" by each campus.

The first iteration of the above process resulted in substantial reallocation of faculty both within and between campuses. Subsequent iterations caused the individual ratios to be adjusted based upon experience, campus data, and analyses of individual campus priorities. These "judgemental" adjustments resulted in a refined matrix of student-faculty ratios which, when used in simulation of state wide faculty needs, met the following conditions:

1. No individual campus in the state suffered a material loss in faculty numbers.

2. No individual campus in the state experienced a windfall increase in faculty numbers.

3. The bottom line total numbers of faculty generated by the formula for all campuses was within 2% of the total faculty then appropriated by the state legislature. (i.e., the matrix of ratios became a maintenance formula balanced to a given base fiscal year appropriation level.)

Thus, the process produced a maintenance or "status quo" formula.

The resulting matrix of faculty formulas is shown in Table 1. The 144-cell (4x36) matrix was first used for the 1977-78 budget year and has remained in use through the 1981-82 budget cycle. The process was empirical but the results were generally acceptable to both the executive and legislative branches of government who authorized the inclusion of the formula in the request budget instructions for post-secondary institutions. The formula has remained in the instructions through the 1981-82 budget request cycle.

III. Analysis of APCUP Formula

The Developers of the formula recognized that faculty workload consists of several activities, including:

- Number of sections taught per term
- Size of sections taught
- Total numbers of student credit hours produced
- Scholarly or research activity
- Public service performed
- Student outcomes.

The developers were also aware of the dangers of projecting present relationships - translated into various unit costs or ratios - into the future. That is, while marginal costing techniques were not a popular subject of study during the development period, the shortcomings of any formula approach which ignored the non-linear relationship of cost and academic product were recognized by the developers.

TABLE 1

GUIDELINES FOR FORMULA FACULTY

HEGIS CODE	STUDENT/FACULTY RATIOS				DISCIPLINE
	LOWER	UPPER	GRAD 1	GRAD 2	
1	24.00	15.00	8.00	6.00	AGRICULTURE & NATURAL RESOURCES
2	20.00	15.00	11.00	7.00	ARCHITECTURE & ENVIRONMENTAL DESIGN
3	30.00	22.00	11.00	7.00	AREA STUDIES
4	25.00	15.00	8.00	6.00	BIOLOGICAL SCIENCES
5	26.00	22.00	12.00	10.00	BUSINESS & MANAGEMENT
6	21.00	17.00	12.00	10.00	COMMUNICATIONS
7	22.00	12.00	8.00	6.00	COMPUTER & INFORMATION SCIENCES
8	22.00	22.00	12.00	10.00	EDUCATION INCLUDING PHYSICAL EDUCATION
9	19.00	13.00	8.00	7.00	ENGINEERING
10	15.00	10.00	8.00	7.00	FINE & APPLIED ARTS
11	19.00	10.00	9.00	7.00	FOREIGN LANGUAGES
12	17.00	12.00	9.00	7.00	HEALTH PROFESSIONS
13	21.00	13.00	8.00	6.00	HOME ECONOMICS
14	24.00	22.00	14.00	7.00	LAW
15	23.00	14.00	9.00	7.00	LETTERS
16	18.00	15.00	12.00	10.00	LIBRARY SCIENCE
17	25.00	12.00	8.00	6.00	MATHEMATICS
18	NA	NA	NA	NA	MILITARY SCIENCE
19	24.00	12.00	8.00	6.00	PHYSICAL SCIENCES
20	32.00	19.00	9.00	6.00	PSYCHOLOGY
21	25.00	21.00	12.00	10.00	PUBLIC AFFAIRS & SERVICES
22	35.00	20.00	10.00	6.00	SOCIAL SCIENCES
23	25.00	16.00	8.00	7.00	THEOLOGY
49	27.00	21.00	11.00	7.00	INTERDISCIPLINARY STUDIES
50	25.00	22.00	NA	NA	BUSINESS & COMMERCE TECHNOLOGIES
51	18.00	16.67	NA	NA	DATA PROCESSING TECHNOLOGIES
52	12.00	12.00	NA	NA	HEALTH SERVICES & PARAMEDICAL TECHNOLOGIES
53	18.00	11.00	NA	NA	MECHANICAL & ENGINEERING TECHNOLOGIES
54	13.33	13.33	NA	NA	NATURAL SCIENCE TECHNOLOGIES
55	20.00	15.56	NA	NA	PUBLIC SERVICE RELATED TECHNOLOGIES
56	13.33	13.33	NA	NA	VOCATIONAL AGRICULTURE TECHNOLOGIES
57	22.00	22.00	NA	NA	DISTRIBUTIVE EDUCATION
58	13.33	13.33	NA	NA	HOMEMAKING - PREPARATION FOR PERSONAL LIVING
59	21.00	21.00	NA	NA	HOMEMAKING - OCCUPATIONAL PREPARATION
60	18.00	11.00	NA	NA	TRADE & INDUSTRIAL OCCUPATIONS
99	13.33	13.33	NA	NA	REMEDIAL

Finally, the committee, in searching for a methodolgy, did consider several modifications of workload, percent of base, and staffing pattern formulas [6] before deciding upon student credit hour production as the base measure for faculty productivity. The final decision was made from both a political and technical basis. The political atmosphere of the legislature in the mid 1970's can be described from Folger [7] who has commented on the impact of rapid turnover among legislators, the decline of the party system and its influence on public policy formulation, the continued emphasis for accountability measures, and the tax revolt:

> "....the public is not confident that government can handle problems...public officials have low ratings on their performance...education is viewed as an essential service but is delivering declining results..."

The generally negative atmosphere led to basic decisions on formula development which resulted in the use of data readily available and well understood as well as a technique currenty in use: the student-faculty ratio. All other aspects of faculty productivity were essentially ignored except that it was the desire of the developers to "engineer" into the formula quantitative differences in role and mission wherever possible.

A. Examination of the Formula

The 4 x 36 matrix clearly differentiates by level of instruction and by discipline at the same time equity in the distribution of resources is promoted by requiring all campuses, regardless of role and mission, to

request resources at the same productivity level for instruction at a given level and discipline. Role differentiation is promoted, however, by providing the opportunity for resources only if the requesting institution has students at a given level and in a discipline. For example:

1. If a campus does not have doctoral programs, no resources would be forthcoming from the graduate 2 level.

2. If a campus did not have an agriculture program (or service courses in HEGIS 100), no resources would be generated at any level of instruction from activity in HEGIS 100.

Thus, role differentiation is promoted by overlaying each campuses' student mix, by discipline and level, on the matrix of ratios. Because each campus has a unique mix of students (by discipline and level), a unique subset of student/faculty ratios are employed by each institution. Because the student/faculty ratios vary by discipline and level, not only is role differentiation promoted, the research function of faculty productivity is indirectly recognized by the generally lower ratios at the graduate 1 and 2 levels. In practice, the faculty needs cell by cell are summed to an over all need and presented in both the request budget and state appropriation as a single campus student-faculty ratio (see Table 2).

Formula Faculty Appropriation

Table 2

	1979-80 Appropriation		1980-81 Appropriation	Explanation
C.U.-Boulder	1,162.1		1,156.1	98% of APCUP formula adjusted for enrollment mix change, plus 5.0 unfunded FTE
C.U.-Denver	307.2		307.0	98%, adjusted for graduate student reporting change
C.U.-Colorado Springs	168.5		173.8	98%, adjusted for enrollment increases
Colorado State University	986.3		977.3	98%, adjusted for enrollment mix change
Fort Lewis College	138.5		146.5	98% of formula adjusted for increasing enrollments
Adams State College	110.3		103.7	98% of formula adjusted for declining enrollments
Mesa College	133.6		134.8	98% of formula adjusted for increasing enrollments and final phase of exception for developing institution
Metropolitan State College	461.5		446.3	98% of formula adjusted for declining enrollments
University of Southern Colorado	225.7		224.1	98% of formula
Western State College	159.8		166.2	98% of formula adjusted for increasing enrollments
University of Northern Colorado	594.2		595.3	98% of formula
Arapahoe Community College	161.1		161.1	98% of formula
Denver Community College	486.7		464.5	98% of formula
Pikes Peak Community College	194.5		212.6	98% of formula
Lamar Community College	22.0		22.0	98% of formula plus 3.7 FTE for small school exception
Morgan Community College	16.8		18.0	98% of formula plus 1.7 FTE for small school exception
Otero Junior College	33.9		36.9	98% of formula plus 3.6 FTE for small school exception and 3.0 FTE for directed studies
Pueblo Vocational Community College	38.9		49.3	98% of formula
Trinidad State Junior College	65.0	63.0	63.0	98% of formula plus 1.5 FTE for small school exception

Source: "Appropriation Report" The Colorado Legislative Joint Budget Committee, 1980-81 Fiscal Year, pg. 57.

B. Testing Formula Against Objective Criteria

Halstead[8] Allen and Topping[9] and Messinger[10] appear to focus upon the following criteria for evaluating a formula design:

1. Validity - Does the formula posses a logical rationale and does it measure what it purports to measure?

2. Quantitative Definability - Does the formula express variables in terms which are recognized by all parties involved.

3. Sensitivity to Change - Does the formula describe workload changes stemming from changes in service demands and growth rates?

4. Adaptability - Does the formula permit the inclusion of differences in existing programs?

An evaluation of the APCUP formula yields the following observations:

Validity - The formula matrix of ratios measures exactly what it purports to measure - instructional workload. As stated in the initial discussion, the matrix of ratios also discriminates between disciplines and levels and thus promotes role differentiation.

Quantitative Definability - The basic variables listed in the formula - student and faculty numbers - were well understood, annually reported, and generally accepted by all affected agencies. Because

the data had been reported for a few years, problems with definitions and comparable reporting caused only moderate stress during the first few years of using the formula.

Sensitivity to Change - Because the formula differentiates students - and resulting faculty needs - by discipline and level, the formula is highly sensitive to changes in student mix as well as student numbers. The sensitivity is so great, however, that on a cell by cell basis the linear relationship of student and faculty - even when generalized to an over all campus student-faculty ratio (which is the current legislative practice) - produced too high a sensitivity in the minds of many academic managers.

Adaptability - The formula produced mixed results in terms of adaptability. While role differentiation is promoted by using a rather extensive matrix of ratios, the relative sensitivity at each cell (i.e., given discipline and level) is not present. For example, why should a university and a small, rural community college both receive the same resource recognition need for lower division English? Also, even if graduate 1 and 2 ratios are lower than undergraduate ratios, do these lower ratios adequately reflect the research role of graduate faculty? And finally, assume the case of two campuses having the same graduate program in biology: if one campus was recognized as a center of excellence in graduate biology - or internationally recognized for its quality program - the formula would not differentiate resource need for the one campus relative to the other.

Thus, in terms of adaptability the formula falls short in many instances in balancing adequate equity and role defferentiation. In defense of the formula, the fact that all resource needs, cell by cell, are summed to an overall campus level ratio moderates the above mentioned shortcomings because the campus, having received a block of faculty FTE undifferentiatied by discipline and level, is able to allocate faculty resources according to its own priorities.

C. Appropriation Experience Using the Formula

Messinger[11] has stated that formula budgeting can cause problems when the formula does not succeed in reducing the uncertainties (i.e., areas of discretion) and establishing the limits of the debate over resource needs. The APCUP formula, because of its complexity and the manner in which it was developed, was only partially successful in avoiding the warnings of Messinger.

1. Complexity - A 4 x 36 matrix of ratios proved to be difficult to comprehend by legislators, particularly the members of the appropriation committee. The result was that the formula appeared to be a "black box" which only legislative technical staff could begin to understand. The campuses were, therefore, greatly exposed to the personal value systems of the staff who had to take considerable time to understand the formula. Because staff turnover is generally higher than in the legislature itself, the situation became one of constant reeducation.

2. Debate Limits - Because of the need for constant reeducation, the central fact that the APCUP formula was designed to produce a "maintenance" level of faculty was lost. The campuses were quickly placed in a position of defending what was generally believed to be an "optimum" formula. The result was that the faculty numbers have been traditionally appropriated at only 98 percent of formula. (Table 2) For at least 20 percent of the campuses, the result was a net reduction in faculty or a basic inability to request needed additional faculty (i.e., the "cushion" provided by the formula was lost).

Certain technical matters evolved during the period of use of the formula which caused additional loss in faculty. The collection and reporting of student FTE, while based upon state wide guide lines, was an evolving process. For example, technical changes occured which altered the number of graduate students reported by the institutions: The number of student thesis credit hours accepted by the state for appropriation purposes was reduced.

The adjustment had a moderate impact upon research universities (approximately 1% of faculty).

A final adjustment had major impact upon one campus, the University of Colorado at Boulder. The legislature determined that ten years was sufficient time to encorporate several "soft money" faculty into the general faculty ranks. These faculty, hired in the 1960's as part of the Science Development Act, (which resulted in several large research

facilities being constructed at Boulder) were not originally included in the formula. As a result of being an "exception", the faculty were exposed and funding for them was lost.

The legislature did provide, however, exceptions for faculty numbers at very small institutions where diseconomies of scale were not sufficiently accounted for in the formula.

The net result of the above activities yielded the following "track record" in the use of the APCUP formula:

1. The decline in faculty numbers state wide, after adjusting for enrollment changes, was confined to approximately 2 percent of 1974-75 faculty staffing levels (1974-75 was the benchmark year from which the formula was developed).(12)

2. Loss of faculty was disproportionately distributed, however, as the major losses were primarily focused upon the two state research universities.

3. The complexity and general debate over the formula had produced a concensus by the fourth year of its use that it was time to modify, upgrade, or replace the formula.

In short, the formula achieved one goal - that of moderating the decline of faculty resources - but failed to reduce the general debates over equity, role differentiation, and appropriate funding levels. The result was a new effort,

directed by the legislature and administered by the state coordinating commision, to modify or replace the formula. The next sections chronicle and analyze the results of the new effort.

IV. Revision of the APCUP formula (1980)

A. Legislative Climate

By the fourth year of its use, the APCUP formula had come under severe criticism from many perspectives:

1. In the aggregate, all institutions were treated the same, regardless of role and mission.

2. The legislature has only one decision point, namely what percent of the aggregate formula to fund.
   (Note: This critically limited policy debate.)

3. The current formula had not been modified, since its inception, to take into account actual practice.

4. The single point of reference of the formula was the Colorado historical perspective. The relative status of Colorado institutions to other states was being ignored.

5. The legislature had come to believe that formulas and student-faculty ratios were for control at the descipline level. The legislature did

not understand, or refused to accept, that control was at the total faculty produced and that formula to actual variances at the matrix-cell level was acceptable and appropriate.

About the same time, researcher Thomas Mason was contracted by the Colorado Commission on Higher Education (CCHE) to do a study (directed by the legislature) and provide recommendations regarding faculty productivity. Among the recommendations of the Mason report were:

1. ...That the CCHE establish early in 1980 a task force for revision of the (faculty) formula budget guidelines.

2. ...That the task force analyze in detail instructional data, actual discipline student faculty ratios, and related instructional indicators.

In April 1980, the CCHE began to move quickly by forming a "Formula Budget Policy Advisory Group" (PAG) consisting of educators, legislators, and lay persons. The PAG received assistance from a technical support group which was charged to develop and analyze policy alternatives. Analysis began in May 1980, and the technical group quickly focused upon the following options (which could be employed individually or in combination):

1. Reducing the number of "cells" in the existing formula by collapsing related disciplines into a single "aggregate discipline."

2. Updating existing formula by adjusting, cell by cell, the student faculty ratios to current parctice.
3. Creating a matrix of ratios unique to a given campus or a group of campuses.

4. Developing an overall student faculty ratio for each campus or selected groups of campuses.

5. Use of other criteria, such as instructional cost per student or faculty, as either a substitute or a "proxy" for faculty numbers.

6. Development of external (out of state) groups of institutions which could be used for comparisons with individual or groups of Colorado institutions.

The first comprehensive proposal made public by the Commission's Advisory Group and described in a CCHE agenda (see Appendix I) included these characteristics:

1. Grouping of Colorado institutions into four "sectors."

2. Using Carnegie Classifications to develop the sectors.

3. Developing an APCUP style matrix of student-faculty ratios for each sector.

4. Given #3, directly above, using current institutional practice to refine the matricies of ratios.

5. Using of NCHEMS and similar data bases to establish external funding reference levels, including:

   - o National Average Instructional cost per FTE student,
   - o Colorado Instructional cost per FTE student,
   - o National and Colorado average faculty costs,
   - o Sector student-faculty ratios (Colorado and Carnegie).

The proposal split the higher education community in Colorado. Arguments for the proposal focused on:

1. The approach incorporated the use of external comparisons that were formerly not a part of the formula.

2. The use of five tables of student-faculty ratios would bring the formulas more in line with current practice.

3. The NCHEMS data was readily acceptable and could be used in the 1981 legislative session.

4. The legislature would have a tool to differentiate funding by educational sector.

5. The proposed process is not significantly different from the current process.

Arguments against the proposal included:

1. The non-comparability of data reported by institutions to NCHEMS (note: The allegations were that the NCHEMS data base contained sufficient variances in the use of data definitions and reporting terms that its lock-step use as a specific funding mechanism was inappropirate).

2. The use of Carnegie classifications to group Colorado institutions for specific funding decisions was inappropriate because the Carnegie scheme - while useful for general role and mission analysis - was too general for use as an appropriation mechanism. (Note: one institution went so far as to contact the developers of the Carnegie scheme and verify the allegation.)

3. The "sectoring" as shown would group Colorado institutions with significantly different roles and missions; homogenization of role and mission and funding levels would result. In addition, the long term planning approach in Colorado has been to promote role differentiation not homogenization.

4. The use of instructional cost data as a proxy for faculty resource need is too general and analytically weak.

5. Exact appropriation mechanisms were not disclosed.

6. The process constituted a significant change from the current mode and the impact had not been assessed.

The debate was long and detailed. Several alternatives were suggested, including "blue ribbon" panels, development of more sophisticated peer group analysis processes, and the urging of a policy which would link individual Colorado institutions to its "appropriate" external comparison group. Efforts to refine the HEGIS data base were also urged.

The Policy Advisory Group then adopted eight principles for guiding the formula revision. The principles are shown in Appendix II. Included in these principles was a major concession: The existing single matrix formula of student-faculty ratios (i.e., the APCUP formula) was to be retained for the next fiscal year. The original position of using student costs (Appendix I) was continued but in a modified form.

Note: One fact became clear to all parties; comparison group analysis and its translation into an appropriations mechanism was exceedingly difficult from a technical standpoint and politically sensitive in its evolution.

Impasse was reached and then broken a few weeks later by a proposal suggested by the State College Consortium headed by John Marvel.[13] The proposal, in summary form was:

1. Use an accepted external reference (i.e., Minter Bowen[14]) for "benchmark" student faculty ratios.

2. Use NCHEMS-HEGIS cost data not as a proxy for faculty staffing needs but as a direct dollar "benchmark" for unit instructional costs.

3. Array in-state and external comparison information in such a way the legislature could either treat Colorado campuses individually or as a group in analyzing Colorado funding levels with external reference data.

4. Treat the above steps as an interum measure for legislative use for the 1981-82 appropriation, but continue to refine the development of external comparison groups and continue to study the options related to sectoring, APCUP formula modification, and unit costing.

The basic proposal was modified during a series of state-wide higher education negotiations and presented to the legislature after approval by the state's coordinating commission. The comparison data is shown in Tables 4 and 5. The comparison data desplayed in the tables is derived from campus financial records, the Minter-Bowen study, and the HEGIS data on instructional costs per student collected by the federal government from institutions of higher education across the country. Great flexibility has been provided for "customizing" appropriations campus by campus with reference to external comparison data.

The commission also recommended an implementation plan for 1982-83 similar to the state college proposal.

Table 4
COMPARATIVE DATA FOR TWO GROUPS OF COLORADO INSTITUTIONS

	Student/Faculty Ratio Comparisons						Instructional Cost Comparisons			
	1977-78		1978-79		1979-80		1977-78		1978-79	
	Actuals	Minter & Bowen Samples	Actuals	Minter & Bowen Samples	Actuals	Minter & Bowen Samples	Actuals	Minter & Bowen Samples	Actuals	Minter & Bowen Samples
University of Colorado-Boulder	16.8	Minter and Bowen found the Research & Doctoral Institutions to have an average of 14.8 & the Comprehensive Colleges and Universities to have a ratio of 17.7 for an overall of 15.8**	16.8	Minter and Bowen found the Research & Doctoral Institutions to have an average of 14.8 & the Comprehensive Colleges & Universities to have a ratio of 15.5**	17.3	Minter and Bowen found the Research & Doctoral Institutions to have an average of 14.9 & the Comprehensive Colleges & Universities to have an average of 17.6 for an overall of 15.7**	$1,677	Minter and Bowen sample institution show $2,634 in instructional cost per student for Research & Doctoral Institutions and $1,433 for Comprehensive Colleges & Universities for an overall average of $2,251**	To be completed when available.	To be completed when available.
University of Colorado-Denver	18.2		17.4		17.2		1,002			
University of Colorado-Colo. Springs	19.7		19.2		18.7		1,027			
University of Colorado-H.S. Center	6.2		6.2		6.2		14,629			
Summary of Institutions of Board of Regents	15.7		15.5		15.7		$2,100			
Colorado State University	17.0		16.4		16.5		$1,904			
Without Vet. Med.	17.5		17.3		17.5		Not Readily Separated			
Vet. Med.	8.9		7.2		7.2		1,495			
University of Southern Colorado	19.6		19.8		19.8		1,177			
Fort Lewis College	22.7		22.5		21.9					
Summary of Institutions of Board of Agriculture	18.0		17.6		17.5		$1,749			
Adams State College	19.6		19.6		19.4		$1,684			
Mesa College	19.0		20.0		19.8		1,282			
Metropolitan State College	22.0		20.9		21.0		1,003			
Western State College	20.5		19.7		19.7		1,117			
Summary of the Institutions of the Trustees of State Colleges	20.9		20.3		20.4		$1,193			
University of Northern Colorado	18.7		18.7		18.7		$1,744			
Colorado School of Mines	15.5		15.6		15.6		$2,293			
FOUR-YEAR COLLEGES	17.6	15.8	17.4	15.5	17.4	15.7	$1,772	$2,251		
Arapahoe Community College	22.7	Minter and Bowen Average was 19.8	21.4	Minter and Bowen Average was 20.3	21.4	Minter and Bowen Average was 20.6	$ 953	Minter and Bowen sample institution show $1,033 in instructional cost per student.		
Community College of Denver	22.1		20.7		20.7		1,113			
Pikes Peak Community College	21.9		20.7		20.3		1,426			
Lamar Community College	18.5		18.5		18.2		1,498			
Morgan Community College	18.8		18.8		18.8		1,153			
Otero Junior College	18.8		17.8		17.7		2,909			
Trinidad State Junior College	19.1		18.1		18.*		1,423			
Pueblo Vocational Community College	*		*		16.5					
TWO-YEAR COLLEGES	21.7	19.8	20.4	20.3	20.2	20.6	$1,217	$1,033		

*Part of USC.
**For Comparison Institutions. See Table.

Table 5

INSTRUCTIONAL COST DATA FOR COLORADO INSTITUTIONS*

	1977-78 HEGIS INSTRUCTIONAL COST	1977-78 HEGIS FTE STUDENTS	1977-78 ** INSTRUCTIONAL COST FTE STUDENTS	1978-79 HEGIS INSTRUCTIONAL COST	1978-79 HEGIS FTE STUDENTS	1978-79 INSTRUCTIONAL COST FTE STUDENTS
University of Colorado-Boulder	$33,932,414	20,227	$1,677	TO BE COMPLETED WHEN AVAILABLE THROUGH HEGIS	TO BE COMPLETED WHEN AVAILABLE THROUGH HEGIS	TO BE COMPLETED WHEN AVAILABLE THROUGH HEGIS
University of Colorado-Denver	5,657,503	5,644	1,002			
University of Colorado-Colo. Springs	2,959,034	2,880	1,027			
University of Colo. Health Sciences Ctr.	20,803,571	1,422	14,629			
Summary of the Institutions of the Board of Regents	$63,352,522	30,173	$2,100			
Colorado State University	$32,498,936	17,060	$1,904			
without Vet. Med. School	Not Requested Separately					
Vet. Med School	Not Requested Separately					
niversity of Southern Colorado	7,237,856	4,839	1,495			
Fort Lewis College	3,156,578	2,682	1,177			
Summary of the Institutions of the Board of Agriculture	$42,893,370	24,581	$1,745			
Adams State College	$ 3,347,141	1,987	$1,684			
Mesa College	3,343,639	2,588	1,292			
Metropolitan State College	8,802,266	8,772	1,003			
Western State College	3,413,243	3,057	1,117			
Summary of the Institutions of the Trustees of State Colleges	$18,906,289	16,404	$1,153			
University of Northern Colorado	$18,039,226	10,341	$1,744			
Colorado School of Mines	$ 5,534,910	2,414	$2,293			
FOUR YEAR INSTITUTIONS	$148,726,317	83,913	$1,772			
Arapahoe Community College	$ 3,542,004	3,717	$ 953			
Community College of Denver	10,475,878	9,414	1,113			
Pikes Peak Community College	5,496,301	3,854	1,426			
Lamar Community College	576,605	385	1,498			
Morgan Community College	298,610	259	1,153			
Otero Junior College	1,511,183	520	2,906			
Trinidad State Junior College	1,243,484	874	1,423			
Pueblo Vocational Community College	*	*	*			
Summary of the Institutions of the State Board for Community Colleges and Occupational Education	$23,143,065	19,023	$1,217			
TWO YEAR INSTITUTIONS	$23,143,065	19,023	$1,217			

*Was a part of USC.

* - These data were obtained from NCHEMS and are based on the HEGIS Reports that each institution submitted to the Federal Government.

** - The instructional cost per student was calculated here and brought forward to Table 2.

B. The 1982-83 Fiscal Year Project

During the 1980-81 winter months, the Commissions' Advisory Group and a modified technical support group reviewed the work of the previous year. In March a long term commitment was made to:

1. Persue a more sophisticated external comparison group development and maintenance project.

2. Concentrate on instructional costs per student.

3. Relegate the APCUP formula and student-faculty ratio analysis to an important but secondary role in the hierarchy of analysis.

The more sophisticated external comparison or peer group analyses under active consideration employ complicated statistical techniques i.e., discriminant and factor analysis. The work of Elsass and Lingenfelter[15] and a new study by Marilyn McCoy[16] have become the major tools by which external comparison groups will be developed. The target date for completion of the comparison studies is the Fall of 1981. It may be that both methods will be employed, although cooperation with NCHEMS has been excellent and the McCoy technique, which tends to focus on non-financial attributes of institutions, is being actively developed. Either methodology will provide the basis for implementing the three steps of the 1982-83 budget request year project. At this point in time, however, several valuable lessons have been learned and are being used to increase the chances for success in the final development.

V. Conclusions

As Ben David[18] has written, American higher education is unmatched world-wide in its size, comprehensiveness, differentiation, and egalitarian processes and procedures employed for funding such an establishment must, therefore, be sensitive to the scope of activities. Establishing faculty staffing levels becomes a critical part of the funding analysis, yet little has been learned in the past several decades on how to quantitatively describe faculty activity and work load.[17] Attempts to describe faculty workload usually result in focusing on one or two indicators to the exclusion of all others. The Colorado project was and is guilty of the same limitations. Work continues and may never be complete because the education-financial-political process is ever-changing. Certain techniques and guidelines have come from this process, however, which are of potential use for any administrative and institutional research function engaging in similar efforts.

A. Necessity for Policy Debate

Resource allocation mechanisms, be they formulas, algorithms, or otherwise, must provide the major decision makers:

1. The identification of policy options.

2. The means to debate the options.

3. The ability to quantify the options in such a way that policies can be translated into representative funding levels.

The formula originally produced did not adequately provide for policy debates. The outcome was specific and the means for modifying the outcome lacked an intellectual premise. It became evident to the participants in the revision efforts that no single formula designed to produce a specific appropriation could be made sufficiently adaptable to various funding levels (which reflected different options).

The revision process, by introducing external comparison and "benchmarks" or reference points provided the first steps away from a lock-step deterministic solution to an adaptive process which could produce specific estimates for each of a variety of decisions.

B. Be Very Sensitive to the Political Process

At any time the campus to campus, systems to governing boards, and governing (or coordinating board) to appropriating agency political equations are present and frequently dominant. Establishing credibility with all affected agencies becomes fundamental to successfully introducing a technical procedure into the appropriations process. Higher education must be unified and stand shoulder to shoulder or the political process will dominate, subvert, or otherwise change the process in uncontrolled ways. If the executive branch dominates the process, the governor must know where higher education stands. If the legislature dominates, effective communication must exist between the institutions and the

leadership of the appropriations committees. When the APCUP formula was introduced in 1977, the necessary political linkage existed only to be broken in the months following the next election. Many of the aforementioned fears were realized. The political equation is visible in the thinking of the current effort and legislators have even become a part of the formula development process. With the introduction of more flexible budgeting in Colorado a reality for the next fiscal year, the political equation becomes more of a partnership and the probability for increased credibility is enhanced.

C. Keep the Process Simple

Complicated technical processes are understood by only a few and the temptation to rely on the few or to politically manipulate the outcome can be significant. The original formula is complicated, so much so that the technical staff of the appropriations committees could unduly influence the committee's deliberations. In a short period of time the perception of the formula, its conceptual basis, the degree of flexibility built into the matrix, and its ultimate use became a confusing exercise which left the legislators unable to understand anything but a bottom line appropriation. The "black box" nature of the matrix formula caused great suspicion and made it possible to fund the formula at less that 100%. The fact that it was a maintenance formula was lost and several insitutions suffered as a result. The designers of the formula had taken a calculated risk on recommending a complex process. With respect to marginal changes to state-wide staffing levels, the designers lost the gamble.

D. Avoid Giving Appropriating Agencies the Ability to Reallocate the Funding Base Without a Policy Debate

Technical manipulation of student and faculty data, the use of "exceptions" to formula, "add ons" for small institutions or for "special cases" all served to distort equity in the allocation of resources during the four years the original formula has been used. The new approach, which will focus on the relationship of an individual campus to an external peer group of institutions, will tend to minimize artificial re-allocation of the funding base. Given the student faculty ratios (overall) and instructional unit costs as major determinants for funding, changes in funding base will be with respect to the differences between a campus and its peer group over basic funding criteria. The results should flow from policy discussions which should influence both the request budget and the appropriations legislation.

Postscript

In April, 1981, by legislative action, the Colorado legislature decided to reduce line item accountability and to grant increased flexibility for campuses and their governing boards to manage self generated revenue. The basic premise behind the original formula is no longer very relevant and the need to establish a basis for funding policy debate and not line item variance analysis has increased. The new approach appears compatible with the increased budget flexibility.

Footnotes

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2. James L. Miller, "State Budgeting for Higher Education - The Use of Formulas; Institute of Public Administration, University of Michigan, Ann Arbor, 1964.

3. Observation is based upon the Appropriation Reports and Legislation for the State of Colorado 1970-76 and personal experiences in working with legislative staff from 1973-1976.

4. Ibid

5. Note: The Texas Formula is summerized in Halstead, pp. 674-675. The California formula can be seen, among others, in Messinger, Richard: "State Budgeting for Higher Education: The Uses of Formulas," Center for Research and Development in Higher Education, University of California, Berkeley, 1976 Appendix A.

6. Halstead, op.cit, pp. 671

7. Paul Jedamus, Marvin Peterson and Associates; Bd. Improving Academic Management, A Handbook of Planning and Institutional Research, Chapter 4: "Implications of State Government Changes" by John K. Folger Jossey-Bass, Inc. San Francisco, 1980, pp.679-680.

8. Halstead, op cit pp. 663-664

9. Richard Allen and James Topping: Ed. "Cost Information and Formula Funding";New Approaches chapters 1 and 2 NCHEMS, Boulder Colorado, 1979, pp. 5-13.

10. Messinger, op.cit. pp., 1-15

11. Ibid. pp. 11-12.

12. State Appropriation Reports, 1974-80, The Colorado Legislative Joint Budget Committee.

13. John Marvel, President, Trustees of the State College Consortum and former president of Adams State College. Assisting in the proposal was John Bliss, senior financial staff in the Consortum Office.

14. W. John Minter and Howard R. Bowen, "Preserving America's Investment In Human Capital, a study funded by the Americal Association of State Colleges and Universities, 1980; pp. 21-23.

15. Elsass, James E. and Lingenfelter, Paul E., "An Identification of College and University Peer Groups; Illinois Board of Higher Education, September 1980.

16. McCoy, Marilyn, "*Establishing Peer Groups*"a study to be published initially in dissertation form in the Fall of 1981, University of Colorado, Graduate School of Business.

17. Ben-David, Joseph, American Higher Education, Directions Old and New; The Carnegie Commission on Higher Education, Berkeley, California, 1972; pp.xiii-xv.

APPENDIX I

COLORADO COMMISSION ON HIGHER EDUCATION
1550 Lincoln Street
Denver, CO 80203
September 5, 1980

TOPIC: Revision of Higher Education Faculty Formula

PRESENTED BY: Charlotte Redden

FACULTY FORMULA

CURRENT FORMULA

The faculty formula currently in use has been criticized from several perspectives. All institutions are treated the same, regardless of role and mission. The legislature has had basically one decision point, namely what percent of the aggregate faculty formula to fund. The current formula has not been changed since its adoption five years ago. Actual allocation of faculty therefore is significantly different from the distribution assumed internally in the formula. Finally, the single point of reference of the formula is the Colorado historical experience. Much discussion has revolved around questions of the relative status of Colorado versus other states. Currently, the formula cannot address such questions.

PROPOSED FORMULA

The major characteristics of the proposed formula are as follows:

- Five Sectors - The use of five sectors will recognize the major differences in role and mission of Colorado institutions. The Carnegie classifications have been used to establish Colorado sectors.

  Sector I: "Research and Doctoral Granting Universities I":
  University of Colorado-Boulder, Colorado State University;

  Sector II: "Doctoral Granting Universities I and II":
  University of Northern Colorado;

  Sector III: "Comprehensive Colleges and Universities I and II":
  Adams State, Fort Lewis, Mesa, Metro State, University of Colorado-Denver, University of Colorado-Colorado Springs, University of Southern Colorado, Western State;

  Sector IV: "Two-Year Colleges and Universities":

  All state two-year colleges.

  Sector V: "Schools of Engineering and Technology":
  Colorado School of Mines.

- Actual Faculty Allocations by Sector - The proposed formula contains a separate table for each sector. Each table will be structured by the disciplines and the levels present in the current formula. The most recent actual allocations of faculty by Colorado institutions will be the core of each new table of student/faculty ratios.

- National Points of Reference - NCHEMS will provide national data, including average student/faculty ratios based on all comparable public institutions. The data are defined by Carnegie classifications, as are the Colorado sector identifications. It is intended these NCHEMS data allow, for the first time, a comparison of average Colorado student/faculty ratio by sector with national average student/faculty ratios. The comparisons may be direct or indirect, depending on the methodology finally shown most valid and reliable.

- Sectored Decision Points - Two sets of data for each sector will exist, namely, Colorado sector average student/faculty ratios and the national sector comparison. Budget decisions and requests will establish the recommended relation of the state to the nation.

  Decisions on the number of FTE faculty for each sector may be determined independently of other sectors. Depending upon where each sector falls in comparison to its national equivalents, different percentages may be reasonable. This differentiation allows more equity, in national terms, to be built into the Colorado formula. Determination of the actual budget requests may be more difficult under the proposed formula, but the results should be more responsive to recognized sector needs.

- Small College Needs - Using the NCHEMS data, a specific study is proposed to determine the national relationship between the size of an institution and the student/faculty ratios. To the extent that small enrollments are found to suggest lower student/faculty ratios, the budget requests may need to reflect that finding.

- Envelope of Support - Each institution in a sector would use the same formula table. A total faculty figure would result, as with the current formula. Each institution would continue to allocate the faculty internally as they deem appropriate. The envelope of support concept remains intact in the proposed formula.

Staff will make an oral presentation elaborating on the above points.

APPENDIX II

STATEMENT OF PRINCIPLES
ADOPTED BY POLICY ADVISORY GROUP

1. The faculty formula matrix of student/faculty ratios that is developed for the formula will assume at least the 1980-81 number of faculty positions for each campus. (Hold harmless)

   Explanation--If an institution maintains the same enrollment with an identical distribution of students among the disciplines and levels of the table then the institution will not lose faculty positions as a result of changes in the table of student/faculty ratios.

2. The APCUP faculty ormula matrix will be updated annually on a three-year moving average.

   Explanation--Each year the table of student/faculty ratios will be updated prior to the preparation of the budget requests for the following year. In updating the formula the previous three years of actual data will be used to derive the student/faculty ratio for each discipline and level combination.

3. A small college adjustment will be built into the formula.

   Explanation--Campuses with a low number of enrollments will have an increment of faculity in addition to that defined in the table of student/faculty ratios.

4. The data base for external comparison purposes will be residential instruction cost per student FTE as collected by HEGIS until better information is available.

Explanation--The revised formula budgeting approach includes points of external comparison. The only data collected under a common set of definitions for all public institutions in the nation are the HEGIS data. These data do not include student/faculty ratios and therefore the instructional cost per student will be used as a proxy indicator of student/faculty ratios for comparison purposes. These data will be used for generalizations of the relative status of Colorado sectors, vis-a-vis, other states.

5. For the purpose of comparison with institutions outside the state, Colorado campuses will be grouped as follows:

   a. Colroado State University
      University of Colorado-Boulder;

   b. University of Colorado-Denver
      University of Northern Colorado;

   c. All other four-year colleges and universities except the Colorado School of Mines;

   d. All two-year colleges except the local district colleges;

   e. Colorado School of Mines.

   In addition, there will be developed a separate table of student/faculty ratios for each of these groups.

   Explanation--The sectors are based on instutitional role and mission and correspond roughly to both the Carnegie classifications and Colorado descriptors in the CCHE master plan.

6. External comparisons will be based on Carnegie categories for each group of institutions listed in Principle 5 with the exception of the Colorado School of Mines.

Explanation--Each of the groups of campuses shown in Principle 5 will be compared with the same or similar group of institutions from outside the state. The exception is the School of Mines which will have a unique set of institutions used for comparison purposes.

7. The comparison institutions will be located in the thirteen western states that are a part of the WICHE compact.

Explanation--Colorado has been a member of WICHE since the mid 1950's, and the Legislature and institutions are familiar with this group of states. WICHE states more closely approximate the history and delivery systems for higher education than is true of the nation as a whole.

8. The current table of student/faculty ratios will be the basis of the 1981-82 request budget and the new tables for each group of campuses will be developed as quickly as possible.

Explanation--It would be difficult for the institutions to modify current request budgets in line with a new set of student/faculty ratios. For this reason, the current table of ratios will be used for one more year request.